$25.00

EATON | Cutler-Hammer

GH97A OPEN LOOP INVERTER DRIVE
GH98A CLOSED LOOP VECTOR DRIVE
GH99A OPEN LOOP (SENSORLESS) VECTOR DRIVE

RESPONDOR 9000
AF CRANE CONTROL
USER MANUAL

March 7, 2002

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CUTLER-HAMMER RESPONDOR 9000 USERS MANUAL CONTENTS

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NOTE: For parameter details and other application specific information, please consult the following Respondor 9000 AF Crane Control Application Manuals:
Publication No. 49485 – for AFDs with the standard 24VDC inputs
Publication No. 50248 – for AFDs with the 120VAC input card

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1 SAFETY

ONLY A QUALIFIED ELECTRICIAN SHOULD PERFORM THE ELECTRICAL INSTALLATION

1.1 Warnings

1	Internal components and circuit boards (except the isolated I/O terminals) are at utility potential when the RESPONDOR 9000 is connected to the line. This voltage is extremely dangerous and may cause death or severe injury if you come in contact with it
2	When the RESPONDOR 9000 is connected to the utility, the motor connections U(T1), V(T2), W(T3) and DC-link / brake resistor connections -,+ are live even if the motor is not running
3	The control I/O terminals are isolated from the line potential but the relay outputs and other I/O's (if jumper X4 is in OFF position see figure 6.2.2-1) may have dangerous external voltages connected even if the power is disconnected from the RESPONDOR 9000
4	The RESPONDOR 9000 has a large capacitive leakage current
5	An upstream disconnect/protection device is to be used as noted in the National Electric Code (NEC).
6	Only spare parts obtained from a Cutler-Hammer authorized distributor can be used

1.2 Safety Instructions

1	The RESPONDOR 9000 is meant only for fixed installation. Do not make any connections or measurements when the RESPONDOR 9000 is connected to the utility.
2	After disconnecting the utility, wait until the unit cooling fan stops and the indicators on the control panel are extinguished (if no keypad is present, check the indicators in the cover). Wait 5 more minutes before doing any work on the RESPONDOR 9000 connections. Do not open the cover before this time has run out.
3	Do not make any voltage withstand or megger tests on any part of the RESPONDOR 9000.
4	Disconnect the motor cables from the RESPONDOR 9000 before meggering the motor cables.
5	Do not touch the IC-circuits on the circuit boards. Static voltage discharge may destroy the components.
6	Before connecting to the utility make sure that the cover of the RESPONDOR 9000 is closed
7	Make sure that nothing but a three-phase motor is connected to the motor terminal, with the exception of factory recommended filters.

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1.3 Grounding and ground fault protection

The RESPONDOR 9000 must always be grounded with a grounding conductor connected to the grounding terminal.

The RESPONDOR 9000's ground fault protection protects only the RESPONDOR 9000 if a ground fault occurs in the motor or in the motor cable.

Due to the high leakage current fault current protective devices do not necessarily operate correctly with drives. When using this type of device its function should be tested in the actual installation.

Warning Symbols

For your own safety, please pay special attention to the instructions marked with these warning symbols:

= **Dangerous voltage**

= **General warning**

1.4 Running the motor

1	Before running the motor, make sure that the motor is mounted properly.
2	Maximum motor speed (frequency) should never be set to exceed the motor's and driven machine's capability.
3	Before reversing the rotations of the motor shaft, make sure that this can be done safely.

2 EU-DIRECTIVE

2.1 CE-label

The optional CE-label on the product guarantees the free movement of the product in the EU-area. According to the EU-rules this guarantees that the product is manufactured in accordance with different directives relating to the product.

Cutler-Hammer RESPONDOR 9000s are available with the CE-label in accordance with the Low Voltage Directive (LVD) and the EMC directive.

2.2 EMC-directive

2.2.1 General

The EMC directive (Electro Magnetic Compatibility) states that the electrical equipment must not disturb the environment and must be immune to other Electro Magnetic Disturbances in the environment.

A Technical Construction File (TCF) exists which demonstrates that the RESPONDOR 9000 drives fulfill the requirements of the EMC directive. A Technical Construction File has been used as a statement of conformity with the EMC directive as it is not possible to test all combinations of installation.

2.2.2 Technical criteria

The design intent was to develop a family of drives, which is user friendly and cost effective, while fulfilling the customer needs. EMC compliance was a major consideration from the outset of the design.

The RESPONDOR 9000 series is targeted at the world market. To ensure maximum flexibility, yet meet the EMC needs of different regions, all drives meet the highest immunity levels , while emission levels are left to the user's choice.

The RESPONDOR 9000 does not include the required EMC filter, which is available as an option. For use within the EU the end user takes personal responsibility for EMC compliance.

2.2.3 EMC-levels

The RESPONDOR 9000-series does not fulfil any EMC emission requirements without an optional RFI-filter, either built-in or separate. With an RFI-filter, the drive fulfils the EMC emission requirements in the heavy industrial environment (standards EN50081-2 , EN61800-3).

All products fulfil all EMC immunity requirements (standards EN50082-1,-2 , EN61800-3).

2.2.4 Manufacturer's Declaration of Conformity

Manufacturer's Declaration of Conformity are available upon request.

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3 RECEIVING

This Cutler-Hammer RESPONDOR 9000 drive has been subjected to demanding factory tests before shipment. After unpacking, check that the device does not show any signs of damage and that the RESPONDOR 9000 is as ordered (refer to the model designation code in figure 3-1).

In the event of damage, please contact and file a claim with the carrier involved immediately.

If the received equipment is not the same as ordered, please contact Cutler-Hammer immediately.

Note! Do not destroy the packing. The template printed on the protective cardboard can be used for marking the mounting points of the RESPONDOR 9000 on the panel.

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3.1 Catalog Number

GH 98 A 4 0000 R C M 00 XX X

- Panel Enclosure
- Construction Type
- Expansion Board Options
- Keypad
- Core Drive Enclosure
- Regeneration Type
- Continuous Drive Amps
- Voltage
- Series
- Drive Type

Drive	97	Inverter Drive
	98	Closed Loop Flux Vector Drive
	99	Sensorless Vector Drive
Series	A	Respondor 9000 Series
Voltage	2	200-240 VAC
	3	380-440 VAC
	4	440-500 VAC
	5	575-690 VAC
Regeneration	R	Resistor
	L	Line
Core Drive Enclosure	C	Compact NEMA 1
	N	Std. Chassis
	P	Std Protected Chassis
	S	Std NEMA 1
	J	Std NEMA 12
Keypad	M	Multi-line Alphanumeric
	G	Graphic
Control/ Communication	00	No Modifications
	05	Encoder Board
	03	Encoder Board w/add'l inputs
	Others	Consult Factory
Construction	N00	Customer Mount (Drive only)

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3.2 Storing

If the RESPONDOR 9000 must be stored before installation and startup, check that the ambient conditions in the storage area are acceptable (temperature -40°C - +60°C; (-40°F - + 140°F), relative humidity <95%, no condensation allowed).

3.3 Warranty

This equipment is covered by the Cutler-Hammer standard drive warranty policy.

4 TECHNICAL DATA

4.1 General

Figure 4-1 shows a block diagram of the RESPONDOR 9000 drive.

The three phase *AC-Choke* with the DC-link capacitor forms an LC filter which together with the *Diode Bridge* produce the DC voltage for the IGBT *Inverter Bridge* block. The AC-Choke smooths the HF-disturbances from the utility to the drive and HF-disturbances caused by the drive to the utility. It also improves the waveform of the input current to the drive.

The IGBT bridge produces a symmetrical three phase pulse width modulated AC voltage to the motor. The power drawn from the supply is almost entirely active power.

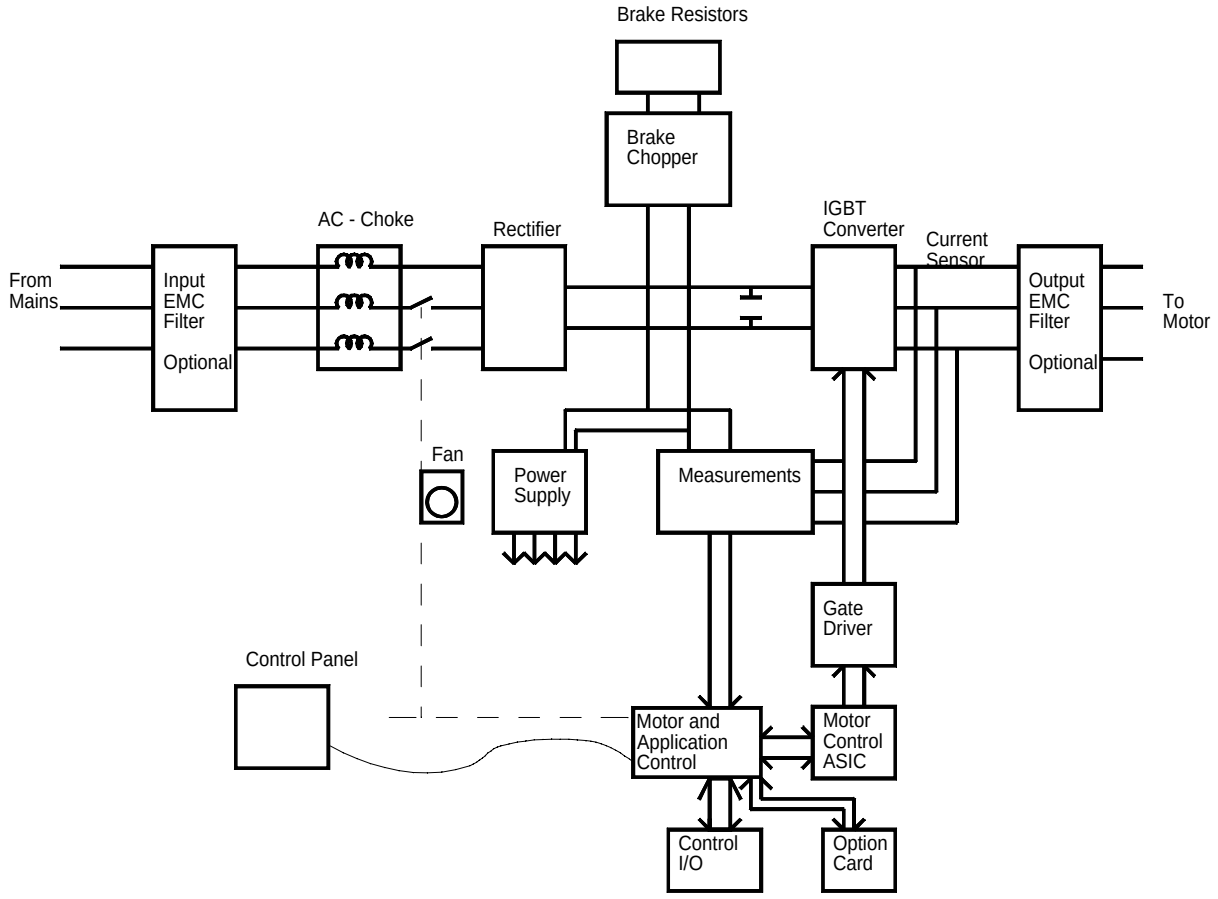
The Motor and Application Control block is based on microprocessor software. The microprocessor controls the motor according to measured signals, parameter value settings and commands from the *Control I/O* block and the *Control Panel*. The Motor and Application Control block gives commands to the *Motor Control ASIC* which calculates the IGBT switching positions. *Gate Drivers* amplify these signals for driving the IGBT inverter bridge.

The Control Panel is a link between the user and the drive. With the panel the user can set parameter values, read status data and give control commands. The panel is removable and can be mounted externally and connected via a cable to the drive.

The Control I/O block is isolated from line potential and is connected to ground via a 1 MW resistor and 4.7 nF capacitor. If needed, the Control I/O block can be grounded without a resistor by changing the position of the jumper X4 (GND ON/OFF) on the control board.

An optional *Brake Chopper* can be mounted in the unit at the factory. Optional I/O-expander boards are also available.

Input and Output EMC-filters are not required for the functionality of the drive, they are only required for compliance with the EU EMC-directive.



4.2 Power Ratings

440 500 VAC, +10% / -15%, 50/60 Hz, 3 phase Input			Standard / Protected Chassis		
Catalog Number ***	Rated Horsepower and output current Constant Torque HP	Ict *	Frame Size / Enclosure Style	Dimensions W x H x D (inches)	Weight (lbs.)
GH97A40005RP	3	5	M4 / Protected	4.7 x 11.4 x 8.5	15.4
GH97A40008RP	5	8			
GH97A40011RP	7.5	11			
GH97A40015RP	10	15	M5 / Protected	6.2 x 15.9 x 9.4	33.1
GH97A40021RP	15	21			
GH97A40027RP	20	27			
GH97A40034RP	25	34	M6 / Protected	87 x 20.7 x 11.4	77.2
GH97A40040RP	30	40			
GH97A40052RP	40	52			
GH97A40065RP	50	65			
GH97A40077RP	60	77			
GH97A40096RN	75	96	M7 / Chassis **	9.8 x 31.5 x 12.4	133
GH97A40125RN	100	125			
GH97A40160RN	125	160			
GH97A40180RN	150	180	M8 / Chassis **	19.5 x 35.0 x 13.9	309
GH97A40260RN	200	260			
GH97A40320RN	250	320	M9 / Chassis **	27.6 x 39.4 x 15.4	485
GH97A40400RN	300	400			
GH97A40480RN	400	480	M10 / Chassis	38.9 x 39.4 x 15.4	684
GH97A40600RN	500	600			
GH97A40700RN	600	700	M11 / Chassis	55.1 x 39.4 x 15.4	948
GH97A40880RN	700	880	M12 / Chassis	77.9 x 39.4 x 15.4	1212
GH97A41020RN	800	1020			
GH97A41070RN	900	1070			
GH97A41200RN	1000	1200			
GH97A41300RN	1100	1300			

* Ict = rated input and output current
** Protected Enclosure with Optional Cover
*** GH97A4, GH98A, and GH99A have the same HP, Ict, Dimensions, and Weight

Table 4.1-1

380 - 440 VAC, +10% / -15%, 50/60 Hz, 3 phase Input			Standard / Protected Chassis		
Catalog Number ***	Rated Power and output current Constant Torque KW	Ict *	Frame Size / Enclosure Style	Dimensions W x H x D (inches)	Weight (lbs.)
GH97A30006RP	2.2	6.5	M4 / Protected	4.7 x 11.4 x 8.5	15.4
GH97A30008RP	3	8			
GH97A30010RP	4	10			
GH97A30013RP	5.5	13			
GH97A30018RP	7.5	18	M5 / Protected	6.2 x 15.9 x 9.4	33.1
GH97A30024RP	11	24			
GH97A30032RP	15	32			
GH97A30042RP	18.5	42	M6 / Protected	87 x 20.7 x 11.4	77.2
GH97A30048RP	22	48			
GH97A30060RP	30	60			
GH97A30075RP	37	75			
GH97A30090RN	45	90			
GH97A30110RN	55	110	M7 / Chassis **	9.8 x 31.5 x 12.4	133
GH97A30150RN	75	150			
GH97A30180RN	90	180			
GH97A30210RN	110	210	M8 / Chassis **	19.5 x 35.0 x 13.9	309
GH97A30270RN	132	270			
GH97A30325RN	160	325			
GH97A30410RN	200	410	M9 / Chassis **	27.6 x 39.4 x 15.4	485
GH97A30510RN	250	510			
GH97A30600RN	315	600	M10 / Chassis	38.9 x 39.4 x 15.4	684
GH97A30750RN	400	750			
GH97A30840RN	500	840	M11 / Chassis	55.1 x 39.4 x 15.4	948
GH97A31050RN	630	1050	M12 / Chassis	77.9 x 39.4 x 15.4	1212
GH97A31270RN	710	1270			
GH97A31330RN	800	1330			
GH97A31480RN	900	1480			
GH97A31600RN	1000	1600			

* Ict = rated input and output current
** Protected Enclosure with Optional Cover
*** GH97A, GH98A, and GH99A have the same HP, Ict, Dimensions, and Weight

Table 4.1-2

440 500 VAC, +10% / -15%, 50/60 Hz, 3 phase Input					NEMA 1
Catalog Number ***	Rated Horsepower and output current Constant Torque HP	Ict *	Frame Size / Enclosure Style	Dimensions W x H x D (inches)	Weight (lbs.)
GH97A40005RS	3	5	M4 / NEMA 1	4.7 x 15.4 x 8.5	17.6
GH97A40008RS	5	8			
GH97A40011RS	7.5	11			
GH97A40015RS	10	15	M5 / NEMA 1	6.2 x 20.3 x 9.4	35.3
GH97A40021RS	15	21			
GH97A40027RS	20	27			
GH97A40034RS	25	34	M6 / NEMA 1	87 x 25.6 x 11.4	83.8
GH97A40040RS	30	40			
GH97A40052RS	40	52			
GH97A40065RS	50	65			
GH97A40077RS	60	77			
GH97A40096RS	75	96	M7 / NEMA 1	14.7 x 39.4 x 13	221
GH97A40125RS	100	125			
GH97A40160RS	125	160			
GH97A40180RS	150	180	M8 / NEMA 1	19.5 x 47.6 x 13.9	309
GH97A40260RS	200	260			
GH97A40320RS	250	320	M9 / NEMA 1	27.6 x 56.1 x 15.4	574
GH97A40400RS	300	400			
GH97A40480RS	400	480	Contact Factory		
GH97A40600RS	500	600			
380 - 440 VAC, +10% / -15%, 50/60 Hz, 3 phase Input					**NEMA 1**
Catalog Number ***	Rated Power and output current Constant Torque KW	Ict *	Frame Size / Enclosure Style	Dimensions W x H x D (inches)	Weight (lbs.)
GH97A30006RS	2.2	6.5	M4 / NEMA 1	4.7 x 15.4 x 8.5	17.6
GH97A30008RS	3	8			
GH97A30010RS	4	10			
GH97A30013RS	5.5	13			
GH97A30018RS	7.5	18	M5 / NEMA 1	6.2 x 20.3 x 9.4	35.3
GH97A30024RS	11	24			
GH97A30032RS	15	32			
GH97A30042RS	18.5	42	M6 / NEMA 1	87 x 25.6 x 11.4	84
GH97A30048RS	22	48			
GH97A30060RS	30	60			
GH97A30075RS	37	75			
GH97A30090RS	45	90			
GH97A30110RS	55	110	M7 / NEMA 1	14.7 x 39.4 x 13	221
GH97A30150RS	75	150			
GH97A30180RS	90	180			
GH97A30210RS	110	210	M8 / NEMA 1	19.5 x 35.0 x 13.9	309
GH97A30270RS	132	270			
GH97A30325RS	160	325			
GH97A30410RS	200	410	M9 / NEMA 1	27.6 x 39.4 x 15.4	485
GH97A30510RS	250	510			
GH97A30600RS	315	600	Contact Factory		
GH97A30750RS	400	750			

Table 4.1-3 and Table 4.1-4

440 500 VAC, +10% / -15%, 50/60 Hz, 3 phase Input					NEMA 12
Catalog Number ***	Rated Horsepower and output current Constant Torque HP	Ict *	Frame Size / Enclosure Style	Dimensions W x H x D (inches)	Weight (lbs.)
GH97A40005RJ	3	5	M4 / NEMA 12	4.7 x 15.4 x 8.5	17.6
GH97A40008RJ	5	8			
GH97A40011RJ	7.5	11			
GH97A40015RJ	10	15	M5 / NEMA 12	6.2 x 20.3 x 9.4	35.3
GH97A40021RJ	15	21			
GH97A40027RJ	20	27			
GH97A40034RJ	25	34	M6 / NEMA 12	87 x 25.6 x 11.4	83.8
GH97A40040RJ	30	40			
GH97A40052RJ	40	52			
GH97A40065RJ	50	65			
GH97A40077RJ	60	77			
GH97A40096RJ	75	96	M7 / NEMA 12	14.7 x 39.4 x 13	221
GH97A40125RJ	100	125			
GH97A40160RJ	125	160			
GH97A40180RJ	150	180	M8 / NEMA 12	19.5 x 47.6 x 13.9	309
GH97A40260RJ	200	260			
GH97A40320RJ	250	320	M9 / NEMA 12	27.6 x 56.1 x 15.4	574
GH97A40400RJ	300	400			
GH97A40480RJ	400	480	Contact Factory		
GH97A40600RJ	500	600			
380 - 440 VAC, +10% / -15%, 50/60 Hz, 3 phase Input					**NEMA 12**
Catalog Number ***	Rated Power and output current Constant Torque KW	Ict *	Frame Size / Enclosure Style	Dimensions W x H x D (inches)	Weight (lbs.)
GH97A30006RJ	2.2	6.5	M4 / NEMA 12	4.7 x 15.4 x 8.5	17.6
GH97A30008RJ	3	8			
GH97A30010RJ	4	10			
GH97A30013RJ	5.5	13			
GH97A30018RJ	7.5	18	M5 / NEMA 12	6.2 x 20.3 x 9.4	35.3
GH97A30024RJ	11	24			
GH97A30032RJ	15	32			
GH97A30042RJ	18.5	42	M6 / NEMA 12	87 x 25.6 x 11.4	84
GH97A30048RJ	22	48			
GH97A30060RJ	30	60			
GH97A30075RJ	37	75			
GH97A30090RJ	45	90			
GH97A30110RJ	55	110	M7 / NEMA 12	14.7 x 39.4 x 13	221
GH97A30150RJ	75	150			
GH97A30180RJ	90	180			
GH97A30210RJ	110	210	M8 / NEMA 12	19.5 x 35.0 x 13.9	309
GH97A30270RJ	132	270			
GH97A30325RJ	160	325			
GH97A30410RJ	200	410	M9 / NEMA 12	27.6 x 39.4 x 15.4	485
GH97A30510RJ	250	510			
GH97A30600RJ	315	600	Contact Factory		
GH97A30750RJ	400	750			

Table 4.1-5 and Table 4.1-6

525-690**** VAC, +10% / -15%, 50/60 Hz, 3 phase Input			Standard / Protected Chassis		
Catalog Number ***	Rated Horsepower and output current Constant Torque HP	Ict *	Frame Size / Enclosure Style	Dimensions W x H x D (inches)	Weight (lbs.)
GH97A50003RP	2	3.5	M5 / Protected	6.2 x 17.3 x 10.4	33.1
GH97A50005RP	3	4.5			
GH97A50007RP	5	7.5			
GH97A50010RP	7.5	10			
GH97A50014RP	10	14			
GH97A50019RP	15	19			
GH97A50023RP	20	23			
GH97A50026RP	25	26			
GH97A50035RP	30	35	M6 / Protected	87 x 24.3 x 11.4	83.8
GH97A50042RP	40	42			
GH97A50052RP	50	52			
GH97A50062RN	60	62			
GH97A50085RN	75	85			
GH97A50100RN	100	100	M8 / Chassis **	19.5 x 35.0 x 13.9	300
GH97A50122RN	125	122			
GH97A50145RN	150	145			
GH97A50222RN	200	222	M9 / Chassis **	27.6 x 39.4 x 15.4	485
GH97A50287RN	250	287			
GH97A50325RN	300	325	M10 / Chassis	38.9 x 39.4 x 15.4	684
GH97A50400RN	400	400			
GH97A50490RN	500	490	M11 / Chassis	55.1 x 39.4 x 15.4	948
GH97A50620RN	600	620	M12 / Chassis	77.9 x 39.4 x 15.4	1212
GH97A50700RN	700	700			
GH97A50780RN	800	780			

* Ict = rated input and output current
** Protected Enclosure with Optional Cover
*** GH97A, GH98A, and GH99A have the same HP, Ict, Dimensions, and Weight
**** UL listed up to 600 volts

Table 4.1-7

440 500 VAC, +10% / -15%, 50/60 Hz, 3 phase Input					COMPACT NEMA 1
Catalog Number ***	Rated Horsepower and output current Constant Torque HP	Ict *	Frame Size / Enclosure Style	Dimensions W x H x D (inches)	Weight (lbs.)
GH97A40002RC	1	2.5	M3 / Compact NEMA 1	4.7 x 12.0 x 5.9	9.9
GH97A40003RC	1.5	3			
GH97A40004RC	2	3.5			
GH97A40005RC	3	5			
GH97A40008RC	5	8	M4B Compact NEMA 1	5.3 x 15.4 x 8.1	15.4
GH97A40011RC	7.5	11			
GH97A40015RC	10	15			
GH97A40021RC	15	21			
GH97A40027RC	20	27	M5B Compact NEMA 1	7.3 x 22.8 x 8.5	33.1
GH97A40034RC	25	34			
GH97A40040RC	30	40			

Table 4.1-8

380 - 440 VAC, +10% / -15%, 50/60 Hz, 3 phase Input					COMPACT NEMA 1
Catalog Number ***	Rated Power and output current Constant Torque KW	Ict *	Frame Size / Enclosure Style	Dimensions W x H x D (inches)	Weight (lbs.)
GH97A30002RC	0.75	2.5	M3 / Compact NEMA 1	4.7 x 12.0 x 5.9	9.9
GH97A30003RC	1.1	3.5			
GH97A30004RC	1.5	4.5			
GH97A30006RC	2.2	6.5			
GH97A30008RC	3	8			
GH97A30010RC	4	10	M4B Compact NEMA 1	5.3 x 15.4 x 8.1	15.4
GH97A30013RC	5.5	13			
GH97A30018RC	7.5	18			
GH97A30024RC	11	24			
GH97A30032RC	15	32	M5B Compact NEMA 1	7.3 x 22.8 x 8.5	33.1
GH97A30042RC	18.5	42			
GH97A30048RC	22	48			

Table 4.1-9

200-240 VAC, +10% / -15%, 50/60 Hz, 3 phase Input				COMPACT NEMA 1	
Catalog Number ***	Rated Horsepower and output current Constant Torque HP	Ict *	Frame Size / Enclosure Style	Dimensions W x H x D (inches)	Weight (lbs.)
GH97A20003RC	0.75	3.6	M3 / Compact NEMA 1	4.7 x 12.0 x 5.9	9.9
GH97A20004RC	1	4.7			
GH97A20006RC	1.5	5.6			
GH97A20007RC	2	7			
GH97A20010RC	3	10	M4B Compact NEMA 1	5.3 x 15.4 x 8.1	15.4
GH97A20016RC	5	16			
GH97A20022RC	7.5	22			
GH97A20030RC	10	30	M5B Compact NEMA 1	7.3 x 22.8 x 8.5	33.1
GH97A20043RC	15	43			
GH97A20057RC	20	57			

Table 4.1-10

200-240 VAC, +10% / -15%, 50/60 Hz, 3 phase Input			STANDARD / PROTECTED CHASSIS		
Catalog Number ***	Rated Horsepower and output current Constant Torque HP	Ict *	Frame Size / Enclosure Style	Dimensions W x H x D (inches)	Weight (lbs.)
GH97A20007RP	2	7	M4 / Protected	4.7 x 11.4 x 8.5	15.4
GH97A20010RP	3	10			
GH97A20016RP	5	16	M5 / Protected	6.2 x 15.9 x 9.4	33.1
GH97A20022RP	7.5	22			
GH97A20030RP	10	30			
GH97A20043RP	15	43	M6 / Protected	8.7 x 20.7 x 11.4	77.2
GH97A20057RP	20	57			
GH97A20070RP	25	70			
GH97A20083RP	30	83			
GH97A20113RP	40	113	M7 / Chassis	9.8 x 31.5 x 12.4	135
GH97A20139RP	50	139			
GH97A20165RP	60	165			
GH97A20200RN	75	200	M8 / Chassis	19.5 x 35 x 13.9	300

Table 4.1-11

200-240 VAC, +10% / -15%, 50/60 Hz, 3 phase Input					NEMA 12
Catalog Number ***	Rated Horsepower and output current Constant Torque HP	Ict *	Frame Size / Enclosure Style	Dimensions W x H x D (inches)	Weight (lbs.)
GH97A20007RJ	2	7	M4 / NEMA12	4.7 x 15.4 x 8.5	17.6
GH97A20010RJ	3	10			
GH97A20016RJ	5	16	M5 / NEMA12	6.2 x 20.3 x 9.4	35.3
GH97A20022RJ	7.5	22			
GH97A20030RJ	10	30			
GH97A20043RJ	15	43	M6 / NEMA12	8.7 x 25.6 x 11.4	84
GH97A20057RJ	20	57			
GH97A20070RJ	25	70			
GH97A20083RJ	30	83			
GH97A20113RJ	40	113	M7 / NEMA12	14.7 X 39.4 X 13	180
GH97A20139RJ	50	139			
GH97A20165RJ	60	165			
GH97A20200RJ	75	200	M8 / NEMA12	19.5 X 50.8 X 14	337

Table 4.1-12

230 VAC, +10% / -15%, 50/60 Hz, 3 phase Input					NEMA 12
Catalog Number ***	Rated Horsepower and output current Constant Torque HP	Ict *	Frame Size / Enclosure Style	Dimensions W x H x D (inches)	Weight (lbs.)
GH97A20007RS	2	7	M4 / NEMA1	4.7 x 15.4 x 8.5	17.6
GH97A20010RS	3	10			
GH97A20016RS	5	16	M5 / NEMA1	6.2 x 20.3 x 9.4	35.3
GH97A20022RS	7.5	22			
GH97A20030RS	10	30			
GH97A20043RS	15	43	M6 / NEMA1	8.7 x 25.6 x 11.4	84
GH97A20057RS	20	57			
GH97A20070RS	25	70			
GH97A20083RS	30	83			
GH97A20113RS	40	113	M7 / NEMA1	14.7 X 39.4 X 13	180
GH97A20139RS	50	139			
GH97A20165RS	60	165			
GH97A20200RS	75	200	M8 / NEMA1	19.5 X 50.8 X 14	337

Table 4.1-13

4.3 Specifications

Utility Connection	Input voltage V_{in}		380-480V, 460-500V, 525-690V, 200-240V; -15% - +10%
	Input frequency		45 – 66 Hz
	Connection to the mains		Once per minute or less (normally)
Motor Connection	Output Voltage		0 - V_{in}
	Continuous output current		I_{ct} ambient max + 50 C (open chassis) Overload 1.5 x I_{ct} (1 min / 10 min)
	Starting torque		200%
	Starting current		2.5 x I_{ct}: 2 s every 20 x if output frequency < 30 Hz and if the heatsink temperature < + 60 C
	Output frequency		0 – 500 Hz
	Frequency resolution		0.01 Hz
Control characteristics	Control method		Frequency Control (V/Hz) Open Loop Sensorless Vector Control Closed Loop Vector Control
	Switching frequency		1 – 16 KHz (depending on horsepower rating)
	Frequency reference	Analog I/P	Resolution 12 bit, accuracy +/- 1 %
		Panel refer.	Resolution 0.01 Hz
	Field weakening point		30—500 Hz
	Acceleration time		0.1—3000 s
	Deceleration time		0.1—3000 s
	Braking torque		DC brake: 30%*T_N (without brake option)
Environmetal Limits	Ambient operating temperature		10 (no frost)—+50°C at I_{CT}, (1.5 x I_{CT} max 1min/10min)
	Storage temperature		-40°C—+60°C
	Relative humidity		<95%, no condensation allowed
	Air quality - chemical vapors - mechanical particles		 IEC 721-3-3, unit in operation, class 3C2 IEC 721-3-3, unit in operation, class 3S2
	Altitude		1000m (3300 ft) maximum without derating.
	Vibration (IEC 721-3-3)		Operation: max displacement amplitude 3 mm at 2—9 Hz, Max acceleration amplitude 0.5 G at 9—200 Hz
	Shock (IEC 68-2-27)		Operation: max 8 G, 11 ms Storage and shipping: max 15 G, 11 ms (in the package)
	Enclosure		Protected Chassis (IP20) and Chassis (IP20) Compact NEMA 1 (IP20) NEMA 1 (IP21) NEMA 12 (IP54)

Table 4.1-14

EMC	Noise immunity	Fulfils EN50082-1,-2 , EN61800-3
	Emissions	Equipped with an optional external RFI-Filter fulfils EN50081-2 , EN61800-3
Safety		Fulfils EN50178, EN60204 -1,CE, UL, C-UL, FI, GOST R (check from the unit nameplate specified approvals for each unit)
Control connections	Analog voltage	0—+10 V, R_i = 200 kΩ, single ended (-10—+10V , joystick control), resolution 12 bit, accur. ±1%
	Analog current	0 (4) — 20 mA, R_i = 250 Ω, differential
	Digital inputs (6)	Positive or negative logic
	Aux. voltage	+24 V ±20%, max 100 mA
	Pot. meter reference	+10 V -0% — +3%, max 10 mA
	Analog output	0 (4) — 20 mA, R_L <500 Ω, resolution 10 bit, accur. ±3%
	Digital output	Open collector output, 50 mA/48 V
	Relay outputs	Max switching voltage: 300 V DC, 250 V AC Max switching load: 8A / 24 V 0.4 A / 250 V DC 2 kVA / 250 V AC Max continuous load: 2 A rms
Protective functions	Overcurrent protection	Trip limit 4 x I_{CT}
	Overvoltage protection	Utility voltage: 220 V, 230 V, 240 V, 380 V, 400 VTrip limit: 1.47x V_n, 1.41x V_n, 1.35x V_n, 1.47x V_n, 1.40x V_n Utility voltage: 415 V, 440 V, 460 V, 480 V, 500 V Trip limit: 1.35x V_n 1.27x V_n, 1.47x V_n, 1.41x V_n, 1.35x V_n Utility voltage: 525 V, 575 V, 600 V, 660 V, 690 V Trip limit: 1.77x V_n, 1.62x V_n, 1.55x V_n, 1.41x V_n, 1.35x V_n
	Undervoltage protection	Trip limit 0.65 x V_n
	Ground-fault protection	Protects the inverter from an ground-fault in the output (motor or motor cable)
	Motor phase supervision	Trip if any of the output phases is missing
	Unit over temperature protection	Yes
	Motor overload protection	Yes
	Stall protection	Yes
	Motor underload protection	Yes
	Short-circuit protection of +24V and +10V reference voltages	Yes

Table 4.1-14

RESPONDOR 9000
3-KHZ APPROXIMATE WATTS PER AMP DATA

DRIVE FRAME	240 VAC	380 – 480VAC	575 VAC
M3	12	18	N/A
M4	12	18	N/A
M4B	12	18	N/A
M5	12	18	18
M5B	12	16	N/A
M6	12	18	18
M7	12	16	N/A
M8	12	16	16
M9	N/A	16	16
M10	N/A	16	16

Table 4.1-15

5 INSTALLATION

5.1 Ambient conditions

The environmental limits mentioned in table 4.3-1 must not be exceeded.

5.2 Cooling

The specified space around the drive ensures proper cooling air circulation. See table 5.2-1 for dimensions. If multiple units are to be installed above each other, the dimensions must be b+c and air from the outlet of the lower unit must be directed away from the inlet of the upper unit.

When switching frequencies are above 5 KHz the maximum continuous output current needs to be derated. Contact Cutler-Hammer Crane group for assistance.

Frame Size / Enclosure Style	Dimensions (in)			
	a	a2	b	C
M3/Comp. NEMA 1 M4/Prot. & NEMA 12	1	0.5	4	2
M4/NEMA 1	1	1	4	2
M4B/5B Comp. NEMA 1 M5/Prot. & NEMA 12	1	0.5	5	2.5
M5/NEMA 1	1	.	5	2.5
M6/Prot. & NEMA 12	1.5	4	6.5	3.5
M6/NEMA 1	1.5	1.5	6.5	3.5
M7/Chassis* & NEMA 12 M7/NEMA 1	3(1.5)**	3(25)**	12	4
M8/Chassis* & NEMA 12 M8/NEMA 1	10***(3)**	3	12	
M9/Chassis* & NEMA 12 M9/NEMA 1	8***(3)**	3	12	
M10/Chassis* & NEMA 12 M10/NEMA 1	8***(3)**	3	12	
M11/Chassis* & NEMA 12 M11/NEMA 1	Contact Factory			
M12/Chassis* & NEMA 12 M12/NEMA 1				

a2 Distance from inverter to inverter in multiple inverter installations
* Protected enclosure with optional cover.
** Minimum allowable space – No space available for fan change
*** Space for fan change on sides of inverter

Table 5.2-1 Installation space dimensions.

HP (kw)	Voltage / Enclosure	Required Airflow (CFM)
0.75 – 2	230 / Compact NEMA 1	42
2 – 3	230 / Protected & NEMA 1/12	
(0.75 – 5.5)	380 / Compact NEMA 1	
(2.2 – 7.5)	380 / Protected & NEMA 1/12	
1 – 7.5	480 / Compact NEMA 1	
3 – 10	480 / Protected & NEMA 1/12	
2 – 15	600 / Protected	
3 – 15	230 / Compact NEMA 1	100
5 – 10	230 / Protected & NEMA 1/12	
(7.5 – 18.5)	380 / Compact NEMA 1	
(11 – 30)	380 / Protected & NEMA 1/12	
10 – 25	480 / Compact NEMA 1	
15 – 40	480 / Protected & NEMA 1/12	
20 – 60	600 / Protected	
20	230 / Compact NEMA 1	218
15 – 30	230 / Protected & NEMA 1/12	
(22)	380 / Compact NEMA 1	
30	480 / Compact NEMA 1	
(37 – 45)	380 / Protected & NEMA 1/12	
50 – 60	480 / Protected & NEMA 1/12	
75	600 / Protected	
40 – 75	230 / Chassis* & NEMA 1/12	383
(55 – 90)	380 / Chassis* & NEMA 1/12	
75 – 125	480 / Chassis* & NEMA 1/12	
(110 – 160)	380 / Chassis* & NEMA 1/12	765
150 – 200	480 / Chassis* & NEMA 1/12	
100 - 150	600 / Chassis	
(200 – 250)	380 / Chassis* & NEMA 1/12	1148
250 – 300	480 / Chassis* & NEMA 1/12	
175 – 200	600 / Chassis	
(315 – 400)	380 / Chassis* & NEMA 1/12	1736
400 – 500	480 / Chassis* & NEMA 1/12	
250 – 300	600 / Chassis	
(500)	380 / Chassis	2296
600	480 / Chassis	
400	600 / Chassis	
(630 – 1000)	380 / Chassis	3473
700 – 1100	480 / Chassis	
500 - 800	600 / Chassis	
* Protected enclosures with optional cover.		

Table 5.2-2 Required cooling air.

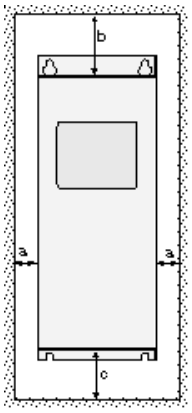


Figure 5.2-1 Installation space

5.3 Mounting

The Respondor 9000 should be mounted in a vertical position on the wall or on the back plane of a cubicle. Follow the requirement for cooling, see table 5.2-1 and figure 5.2-1 for dimensions.

To ensure a safe installation, make sure that the mounting surface is relatively flat. Mounting holes can be marked on the wall using the template on the cover of the cardboard shipping package.

Mounting is done with four screws or bolts depending on the size of the unit, see tables 5.3-1, and figure 5.3-1 for dimensions. Units, from 25 Hp to 500 Hp, have special lifting "eyes" which must be used, see figures 5.3-2 and 5.3-3.

The mounting instructions for units over 500 Hp are given in a separate manual. If further information is needed, contact your Cutler-Hammer distributor.

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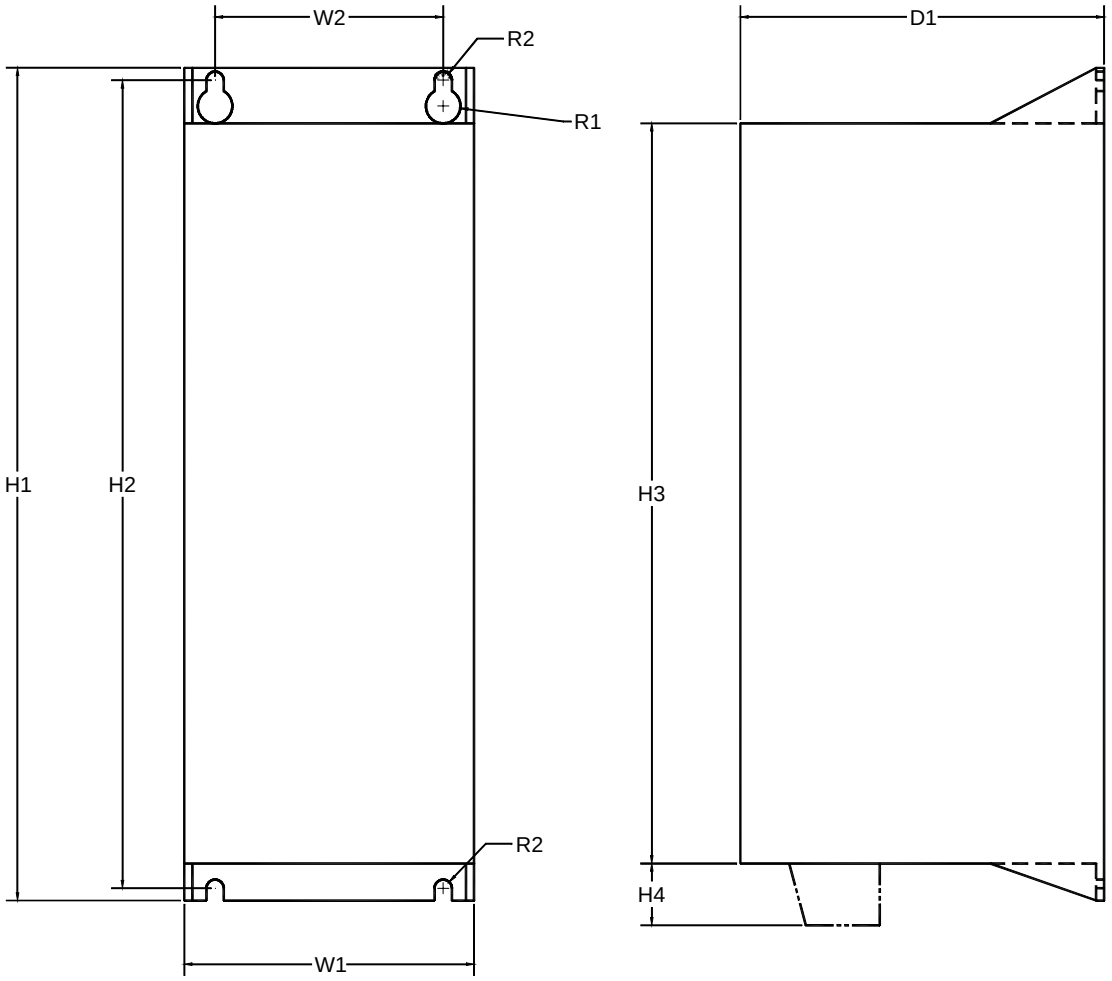


Figure 5.3-1 (see Table 5.3-1 for dimensional information)

Frame	Enclosure	Voltage	Dimensions								
			W1	W2	H1	H2	H3	H4	D1	R1	R2
M3B	Compact NEMA 1	230 / 380 / 480	4.7	3.7	13.5	13.1	12		5.9	0.28	0.14
M4B		230 / 380 / 480	5.3	3.7	17	16.5	15.4		8.1	0.28	0.14
M5B		230 / 380 / 480	7.3	5.5	23.4	22.8	21.7		8.5	0.35	0.18
M4	NEMA 1 / 12	230 / 380 / 480	4.7	3.7	16.7	16.2	15.4		8.5	0.28	0.14
M5		230 / 380 / 480	6.2	5	22.1	21.5	20.3		9.4	0.35	0.18
M6		230 / 380 / 480	8.7	7.1	27.6	26.9	25.6		11.4	0.35	0.18
M7		230 / 380 / 480	14.7	13.6	41.3	40.6	39.4		13	0.35	0.18
M8		230 / 380 / 480	19.5	18	53.1	36.5	50.8		13.9	0.45	0.24
M9		380 / 480	27.6	26	57.9	40.2	56.1		15.4	0.45	0.24
M10		380 / 480									
M4	Chassis / Protected	230 / 380 / 480	4.7	3.7	12.7	12.3	11.4	1.6	8.5	0.28	0.14
M5		230 / 380 / 480	6.2	5	17.8	17.1	15.9	1.8	9.4	0.35	0.18
M5		600	6.2	5	19.1	18.5	17.3	1.8	10.4	0.35	0.18
M6		230 / 380 / 480	8.7	7.1	22.6	22	20.7	3.9	11.4	0.35	0.18
M7		600	8.7	7.1	26.3	25.6	24.3	3.9	11.4	0.35	0.18
M8		230 / 380 / 480	9.8	8.7	33.6	32.9	31.5		12.4	0.35	0.18
M9		230 / 380 / 480 /600	19.5	18	37.4	36.5	35		13.9	0.45	0.24
M10		230 / 380 / 480	27.6	26	41.1	40.2	39.4		15.4	0.45	0.24
M11		230 / 380 / 480	38.9	37.3	41.1	40.2	39.4		15.4	0.45	0.24
M12		230 / 380 / 480									

Table 5.3-1

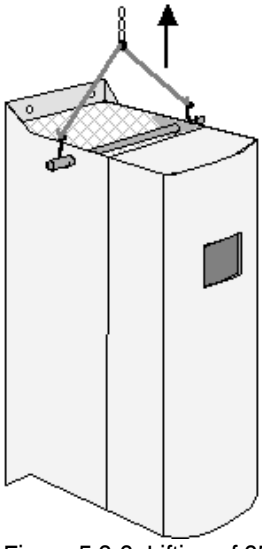
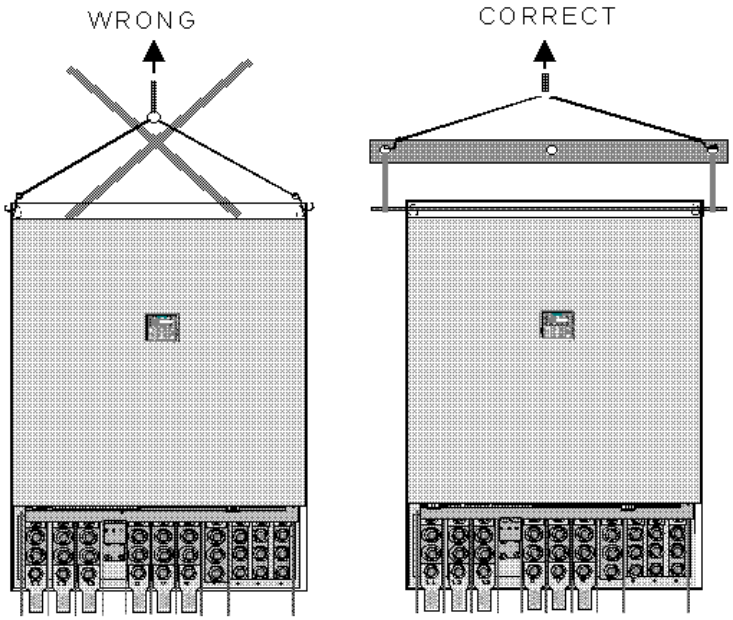


Figure 5.3-2 Lifting of 25 – 125 HP units.



NOTE!
Unit sizes 150 — 500 Hp - do not lift without a rod through the lifting holes in the unit - see above.

M9NOSTO

Figure 5.3-3 Lifting of 150 – 500 HP units

5

6.1 Power connections

Use heat-resistant cables, +60°C or higher. The cable (and the fuses) must be sized in accordance with the rated output current of the unit. Installation of the cable consistent with the UL-instructions is explained in chapter 6.1.4.1.

The minimum dimensions for the Cu-cables and corresponding fuses are given in the tables 6.1-2 — 6.1-5. The fuses have been selected so that they will also function as overload protection for the cables.

Consistent with UL requirements, for maximum protection of the RESPONDOR 9000, UL recognized fuses type RK or industrial thermal magnetic circuit breakers should be used.

If the motor temperature protection (I^2t) is used as overload protection the cables may be selected according to that. If 3 or more cables are used in parallel, on the larger units, every cable must have it's own overload protection.

These instructions cover the case where one motor is connected with one cable to the drive.

Always pay attention to the local authority regulations and installation conditions.

6.1.1 Utility cable

Utility cables for the different EU EMC levels are defined in table 6.1-1.

6.1.2 Motor cable

Motor cables for the different EU EMC levels are defined in table 6.1-1.

6.1.3 Control cable

Control cables are specified in chapter 6.2.1.

6

Cable	Level N	Level I
Utility cable	1	1
Motor cable	2	2
Control cable	3	3

Table 6.1-1

1 = The power cable which is suitable for the installation, ampacity and voltage. Shielded cable is not required.

2 = The power cable contains a concentric protection wire, and is suitable for the ampacity and voltage.

3 = The control cable is a compact low-impedance shielded cable.

480V HP	Ict	Protection Rating	Cu-cable Line & Motor (ground) / mm^2
1	2.5	10	16(16) / 3*1.5+1.5
1.5	3		
2	3.5		
3	5		
5	8		
7.5	11	15	14(14) / 3*2.5+2.5
10	15	20	12(12) / 3*4+4
15	21	25	10(10) / 3*6+6
20	27	35	
25	34	50	8(8) / 3*10+10
30	40	50	
40	52	60	6(6) / 3*16+16
50	65	80	4(6) / 3*25+16
60	77	100	2(6) / 3*35+16
75	96	125	0(4) / 3*50+25
100	125	150	00(2) / 3*70+35
125	160	200	000(0) / 3*95+50
150	180	200	
200	260	300	350MCM / 3*185+95
250	320	400	2x[250MCM(00)] / 2*(3*120+70)
300	400	500	2x[350MCM(000)] / 2*(3*185+95)
400	480	Contact Factory	
500 - 1100			

Table 6.1-2 Mains, motor cables and Protection Rating recommendations according to output currents Ict, 500V range.

600V HP	Ict	Protection Rating	Cu-cable Line & Motor (ground) / mm^2
7.5	10	10	16(16) / 3*1.5+1.5
10	14	15	14(14) / 3*2.5+2.5
15	19	20	12(12) / 3*4+4
20	23	25	10(10) / 3*6+6
25	26	35	
30	35	35	8(8) / 3*10+10
40	42	50	
50	52	60	6(6) / 3*16+16
60	62	60	
75	85	100	2(6) / 3*35+16
100	100	100	
125	122	125	0(4) / 3*50+25
150	145	150	00(2) / 3*70+35
200	222	250	300MCM(00) / 3*150+70
250 - 800	Contact Factory		

Table 6.1-4 Mains, motor cables and Protection Rating recommendations according to output currents Ict, 600V range.

360V HP	Ict	Protection Rating	Cu-cable Line & Motor (ground) / mm^2
.75	2.5	10	16(16) / 3*1.5+1.5
1.1	3.5		
1.5	4.5		
2.2	6.5		
3	8		
4	10		
5.5	13	15	14(14) / 3*2.5+2.5
7.5	18	20	12(12) / 3*4+4
11	24	25	10(10) / 3*6+6
15	32	35	8(8) / 3*10+10
18.5	42	50	
22	48		
30	60	60	6(6) / 3*16+16
37	75	80	4(6) / 3*25+16
45	90	100	2(6) / 3*35+16
55	110	125	0(4) / 3*50+25
75	150	150	00(2) / 3*70+35
90	180	200	000(0) / 3*95+50
110	210	250	300MCM(00) / 3*150+70
132	270	300	350MCM / 3*185+95
160	325	400	2x[250MCM(00)] / 2*(3*120+70)
200	410	500	2x[350MCM(000)] / 2*(3*185+95)
250	510	600	2x[500MCM(250MCM)] / 2*(3*240+120)
315-1000	Contact Factory		

Table 6.1-3 Mains, motor cables and Protection Rating recommendations according to output currents Ict, 400V range.

230V HP	Ict	Protection Rating	Cu-cable Line & Motor (ground) / mm^2
.75	3.6	10	16(16) / 3*1.5+1.5
1	4.7		
1.5	5.6		
2	7		
3	10		
5	16	15	14(14) / 3*2.5+2.5
7.5	22	25	10(10) / 3*6+6
10	30	35	8(8) / 3*10+10
15	43	50	
20	57	60	6(6) / 3*16+16
25	70	80	4(6) / 3*25+16
30	83	100	2(6) / 3*35+16
40	113	125	0(4) / 3*50+25
50	139	150	00(2) / 3*70+35
60	165	200	000(0) / 3*65+50
75	200	200	

Table 6.1-5 Mains, motor cables and Protection Rating recommendations according to output currents Ict, 230V range

Frame	HP (KW)	Voltage	CABLE (AWG / MCM)	
			Main	Ground
M3	ALL	230/380/480	14	14
M4	ALL	230/380/480	10	10
M4B	ALL	230/380/480	6	6
M5	ALL	230/380/480/600		
M5B	10-20	230	2	00
	(15-22)	380		
	20-30	480		
M6	15-30	230		
	18.5-22	380		
	25-30	480		
	30-50	600		
	(30-45)	380	0 Cu, 00 AL	00
	40-60	480		
	60-75	600		
M7	40-75	230	350 MCM	000
	(55-90)	380		
	100-150	480		
M8	(110-160)	380	2x350 MCM Cu 2x500 MCM Al	2x500 MCM
	150-200	480		
	100-150	600		
M9	(200-250)	380	2x600 MCM	2x500 MCM
	250-300	480		
	200	600		
M10	(315-400)	380	4x500 MCM*	2x500 MCM
	400-500	480		
	250-300	600		
M11	(500)	380	Contact Factory	
	600	480		
	400	600		
M12	(630-1000)	380		
	700-1100	480		
	500-800	600		
* NEMA 1 / 12 maximum 3 parallel connected cables can be used				

Table 6.1-6 Maximum cable sizes of the power terminals

6.1.4 Installation instructions

	1	If a RESPONDOR 9000 open chassis unit is to be installed outside a control cabinet or a separate cubicle a protective ÍP20 cover should be installed to cover the cable connections. The protective cover may not be needed if the unit is mounted inside a control cabinet or a separate cubicle. All open chassis RESPONDOR 9000 units should always be mounted inside a control cabinet, or a separate cubicle.
	2	Locate the motor cable away from the other cables: - Avoid long parallel runs with other cables. - If the motor cable runs in parallel with the other cables, the minimum distances given in table 6.1.4-1 between the motor cable and control cables should be followed. - These minimum distances apply also between the motor cable and signal cable of other systems. - **The maximum length of a motor cable can be 600ft (180 m) (except for ratings 1.5 Hp and below max. length is 160 ft (50 m) and 2 Hp max. length 330 ft (100 m)).** The power cables should cross other cables at an angle of 90° degrees. An output dv/dt filter option should be considered for motor cable lengths exceeding 33ft (10m) for drive 2 Hp and below and 100ft (33m) for drives 3Hp and larger if the motor is not designed for inverter duty per NEMA MG1 part 31.
	3	See chapter 6.1.5 for cable insulation checks.
	4	Connecting cables: - Motor and utility cables should be stripped according to figure 6.1.4-2 and table 6.1.4-2. - Open the cover of the RESPONDOR 9000 according to figure 6.1.4-3. - Remove sufficient plugs from the cable cover (open chassis) or from the bottom of the NEMA 1/12 units. - Pass cables through the holes in the cable cover. - Connect the utility, motor and control cables to the correct terminals. See figures 6.1.4-3—16. RESPONDOR 9000 + external RFI-filter: (See RFI-filter option manual). The installation instructions for M11 and M12 frames are explained in the separate manual for M11/M12 units. Contact your Cutler-Hammer distributor for more information. Cable installation consistent with UL-instructions is explained in chapter 6.1.4.1. - Check that control cable wires do not make contact with electrical components in the device. - Connect optional brake resistor cable (if required). - Ensure the ground cable is connected to the -terminal of the frequency converter and motor. - For open chassis units, 150—500 Hp, connect the isolator plates of the protective cover and terminals according to figure 6.1.4-11.

Distance between cables ft (m)	Motor cable length ft (m)
1 (0.3)	≤165 (50)
3.3 (1)	≤600 (180)

Table 6.1.4-1

		- If a shielded power cable is used, connect its shield to the ground terminals of the drive, motor and supply panel. - Mount the cable cover (open chassis units) and the unit cover. - Ensure the control cables and internal wiring are not trapped between the cover and the body of the unit.
	5	**NOTE:** The connection of the transformer inside the unit in frame sizes M7—M12 has to be changed if other than the default supply voltage of the drive is used. Contact your Cutler-Hammer distributor if more information is needed. Voltage Code (VC) — Default Supply Voltage 2 — 230V 4 — 380V 5 — 460V 6 — 600V

6.1.4.1 Cable selection and installation for the UL listing

For Installation and cable connections the following must be noted. Use only with copper wire temperature rating of at least 60/75°C.

Units are suitable for use on a circuit capable of delivering not more than the fault RMS symmetrical amperes mentioned in the table 6.1.4.1-1, 480V maximum.

In addition to the connecting information the tightening torque of the terminals are defined in the table 6.1.4.1-2.

FRAME	Voltage	Maximum RMS symmetrical amperes on connecting circuitry
M4 / M5	380 / 480	5000
M6 / M7		10000
M8 / M9		18000

Table 6.1.4.1-1 Maximum symmetrical supply current

FRAME	HP (KW)	VOLTAGE	Tightening torque (in-lbs.)
M4	All	380 / 480	7
M5	All		20
M6	(18.5 – 22)	380	35
M6	25 – 30	480	35
M6	(30 – 45)	380	44
M6	40 – 60	480	44
M7	All	380 / 480	44
M8	All		610*
M9	All		610*
* The isolated standoff of the bussbar does not withstand the listed tightening torque. Use a wrench to apply counter torque when tightening.			

Table 6.1.4.1-2 Tightening torque.

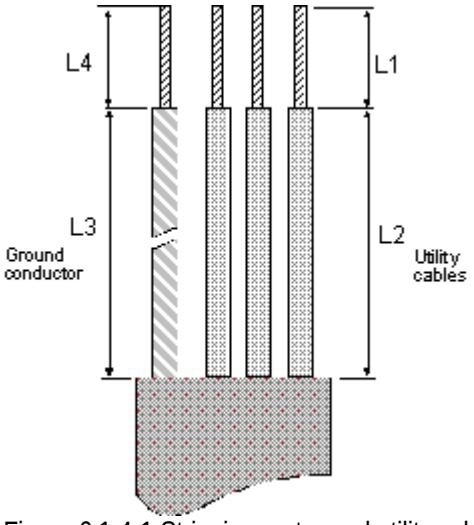


Figure 6.1.4-1 Stripping motor and utility cables

Frame	HP (KW)	Voltage	Shipping Lengths (in)			
			L1	L2	L3	L4
M3	ALL	230/380/480	.47	2.2	2.2	.47
M4	ALL	230/380/480	.24	1.4	2.4	.6
M4B	ALL	230/380/480	.35	1.6	4	.6
M5	ALL	230/380/480/600				
M5B	10-20	230	.6	1.6	4	.6
	(15-22)	380				
	20-30	480				
M6	15-30	230				
	18.5-22	380				
	25-30	480				
	30-50	600				
	(30-45)	380	1	1.6	4	.6
	40-60	480				
	60-75	600				
M7	40-75	230	2			1
	(55-90)	380				
	100-150	480				
M8	(110-160)	380				
	150-200	480				
	100-150	600				
M9	(200-250)	380				
	250-300	480				
	200	600				
M10	(315-400)	380				
	400-500	480				
	250-300	600				
M11	(500)	380				
	600	480				
	400	600				
M12	(630-1000)	380				
	700-1100	480				
	500-800	600				
* NEMA 1 / 12 maximum 3 parallel connected cables can be used						

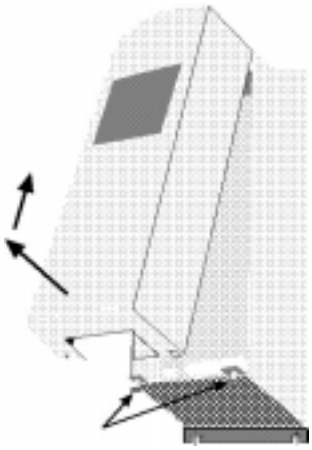
Table 6.1.4-2 Stripping lengths of the cables (in).
Compact NEMA 1 *contact factory

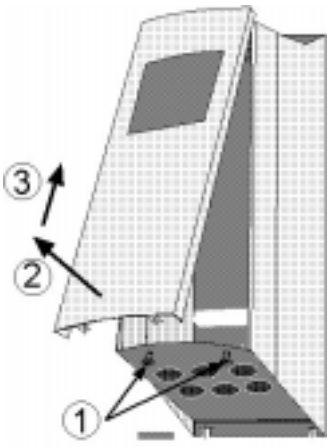
6

1 Loosen screws (2 pcs)

2 Pull cover bottom outwards

3 Push cover upwards





6.1.5 Cable and motor insulation checks

1 Motor cable insulation checks

Disconnect the motor cable from the terminals U, V and W of the RESPONDOR 9000 unit and from the motor.

Measure the insulation resistance of the motor cable between each phase conductor. Also measure the insulation resistance between each phase conductor and the protective ground conductor.
The insulation resistance must be >1 MΩ.

2 Utility cable insulation checks

Disconnect the utility cable from terminals L1, L2 and L3 of the RESPONDOR 9000 unit and from the utility.

Measure the insulation resistance of the utility cable between each phase conductor. Also measure the insulation resistance between each phase conductor and the protective ground conductor. The insulation resistance must be >1 MΩ.

3 Motor insulation checks

Disconnect the motor cable from the motor and open any bridging connections in the motor connection box.

Measure insulation resistance of each motor winding. The measurement voltage has to be at least equal to the utility voltage but not exceed 1000V.
The insulation resistance must be >1 MΩ.

6.2 Control connections

Basic connection diagram is shown in the figure 6.2-1.

6.2.1 Control cables

The control cables should be minimum of #20 gauge shielded multicore cables, see table 6.1-1. The maximum wire size rating of the terminals is #14.

6.2.2 Galvanic isolation barriers

The control connections are isolated from the utility potential and the I/O ground is connected to the frame of the RESPONDOR 9000 via a 1 MΩ resistor and 4.7 nF capacitor. The control I/O ground can also be connected directly to the frame, by changing the position of the jumper X4 to ON-position, see figure 6.2.2-1.

Digital inputs and relay outputs are isolated from the I/O ground.

Specific connections for crane applications are found in the Respondor 9000 Application Manual, publication 49485, figures A.2-1 through 6.

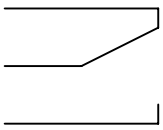
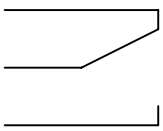
Terminal		Function	Specification
1	+ 10 V ref	Reference voltage output	Burden max 10 mA *
2	V in +	Analog signal input	Signal range –10 V - + 10 V DC
3	GND	I/O ground	
4	I in +	Analog signal (+input)	Signal range 0 (4) – 20 mA
5	I in -	Analog signal (-input)	
6	24 V out	24 V supply voltage	+/- 20%, load max. 100 mA
7	GND	I/O ground	
8	DIA1	Digital input 1	Ri = min 5 k ohm
9	DIA2	Digital input 2	
10	DIA3	Digital input 3	
11	CMA	Common for DIA1 – DIA3	Must be connected to GND or 24V of I/O – terminal or to external 24 V or GND
12	24V out	24 V supply voltage	Same as # 6
13	GND	I/O ground	Same as # 7
14	DIB4	Digital input 4	Ri = min 5 k ohm
15	DIB5	Digital input 5	
16	DIB6	Digital input 6	
17	CMB	Common for DIB4 – DIB6	Must be connected to GND or 24V of I/O – terminal or to external 24 V or GND
18	I out +	Analog signal (+output)	Signal range 0 (4) – 20 mA
19	I out -	Analog signal (-output)	R_L max. 500 ohm
20	DO1	Open collector output	Transistor output, max. Vin = 48 VDC Max. current 50 mA
21	RO1/1	 Relay output 1	Max. switch. Voltage 250 VAC, 300 VDC
22	RO1/2		Max switch. Current 8 A / 24 VDC
23	RO1/3		0.4 A / 250 VDC
24	RO2/1	 Relay output 2	Max switch. Power < 2 kVA / 250 VAC
25	RO2/2		Max. cont. current < 2 A RMS
26	RO2/3		

Figure 6.2-1 Control I/O – terminal signals

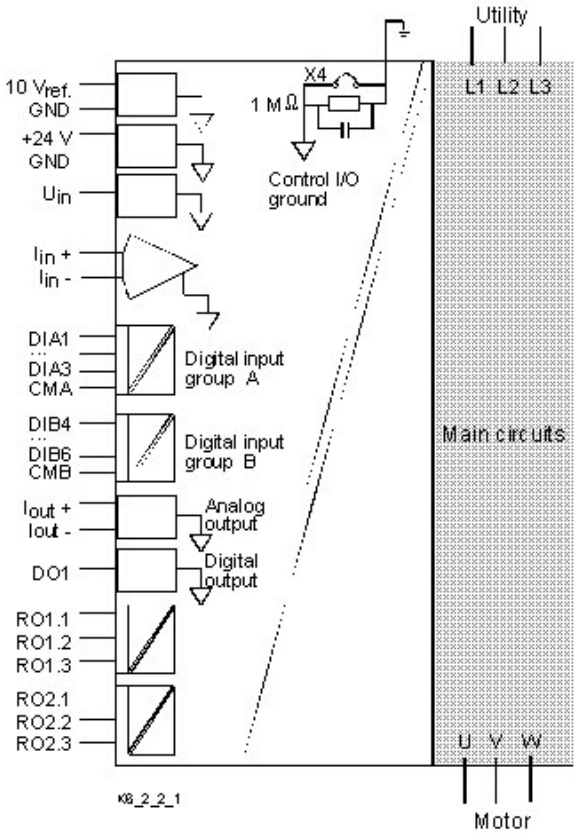


Figure 6.2..2-1

6.2.3 Digital input function inversion

The active signal level of the digital input logic depends on how the common input (CMA, CMB) of the input group is connected. The connection can be either to +24 V or to ground. See figure 6.2.3-1.

The +24V or ground for the digital inputs and common terminals (CMA, CMB) can be either external or internal (terminals 6 and 12 of the drive).

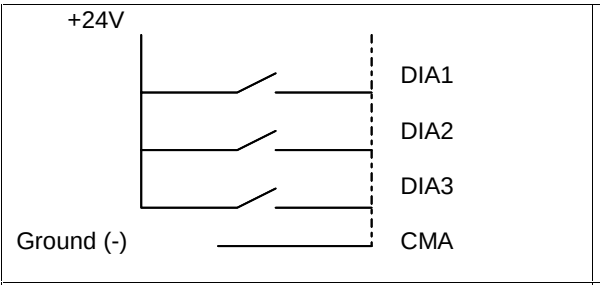
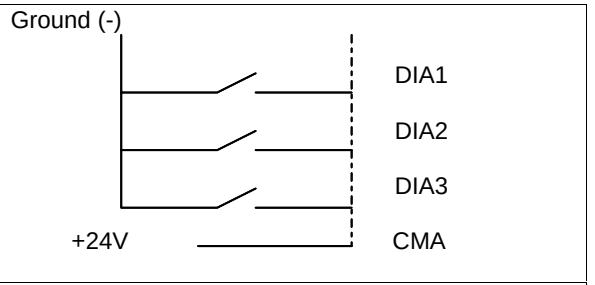
	
Positive logic (+24 V active signal) = input is active when the switch is closed.	Negative logic (0 V active signal) = input is active when the switch is closed.

Figure 6.2.3-1

7. CONTROL PANEL

7.1 Introduction

The control panel of the RESPONDOR 9000 drive features an alphanumeric Multiline Display with five indicator for the Run status (Run, Ready, Fault, ↻ ↺, Stop) and two indicators for the control source. Additional, the panel embodies three indicator lines for the menu/submenu description and the value/amount of the submenus. The eight push buttons on the panel are used for panel programming and monitoring. The panel is detachable and isolated for the input line potential.

The display examples in this chapter present the alphanumeric par to the Multiline Display only. The indicators are not included in the examples.

Control panel with LED display

Drive Status Indicators

RUN	=	Lights when motor is running
↻ ↺	=	Shows the selected rotation
STOP	=	Lights when motor is not running
READY	=	Lights when input voltage is supplied and the unit is ready for use
FAULT	=	Lights when a fault in frequency converter occurs
Panel/ Remote	=	Shows the achieve control source

◁ = *Menu button (left)*
Move forward in the menu

▷ = *Menu button (right)*
Move backward in the menu

UP = *Browser button (up)*
Moves in the main menu and between pages inside the same submenu.
Change value

DOWN = *Browser button (down)*
Move in the main menu and between pages inside the same submenu.
Change value

ENTER = *Enter button*
Acknowledgment of changed value.
Fault history reset.
Function as programmable button.

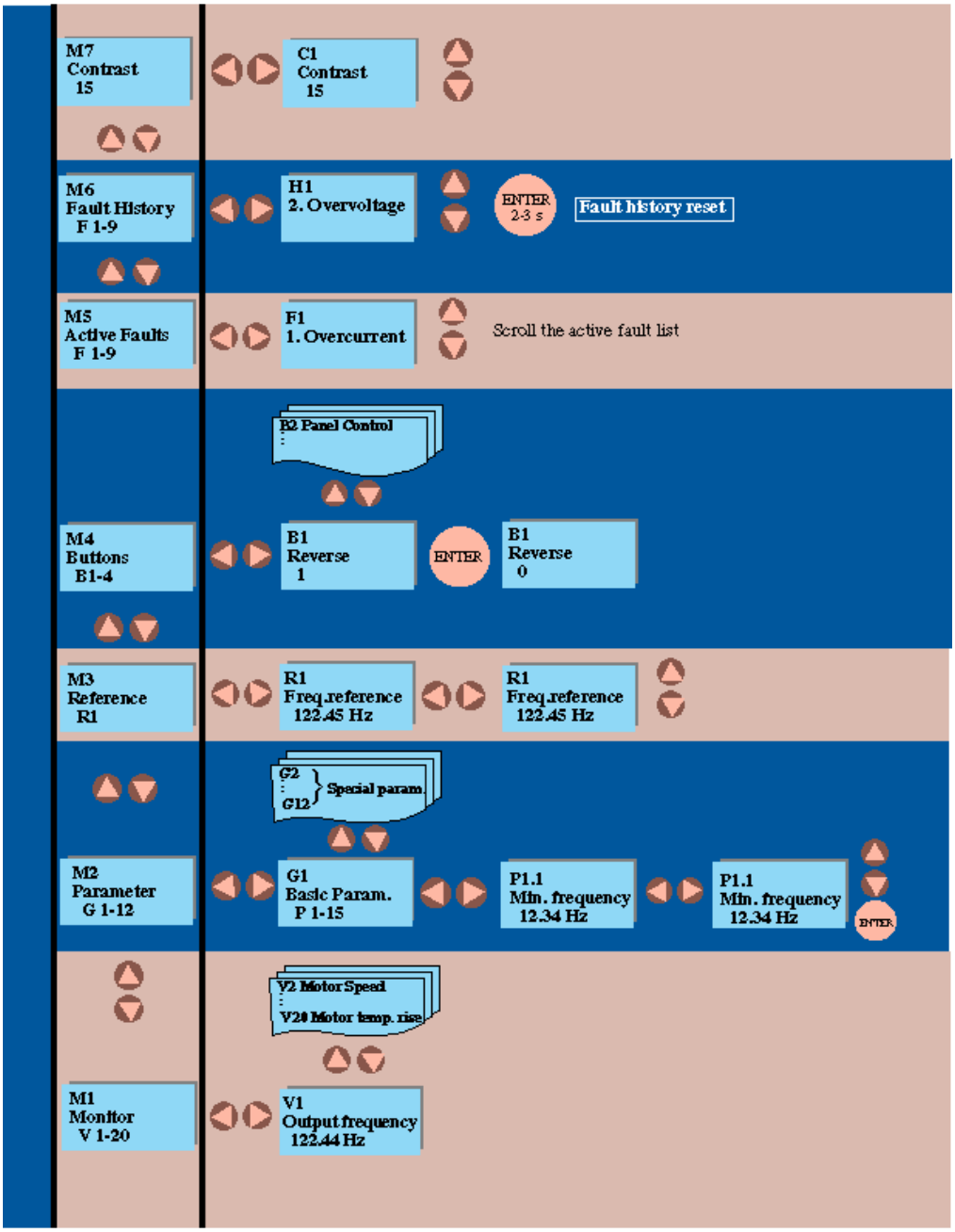
RESET = *Reset button*
Fault resetting

START = *Start button*
Starts the motor if the panel is the active control source

STOP = *Stop button*
Stops the motor if the panel is the active control source

7.2 Panel operation

The panel is arranged in menus and submenus. The menus are used for measurement and control signals, parameter settings, reference values, fault displays, contrast and the programmable buttons.
The desired submenu can also be entered from the main menu by using the menu buttons when the letter M and the number of the menu in question are visible on the first line of the display. See the RESPONDOR 9000 User's and Application Manual for the specific parameters available for the RESPONDOR 9000 setup needed.



7.3 Monitoring menu

The monitoring menu can be entered from the main menu when the symbol **M1** is visible on the first line of the Multiline display. How to browse through the monitored values is presented in Figure 7.3-1. All monitored signals are listed in Table 7.3-1. This menu is meant only for signal checking. The values cannot be altered here. See 7.4 Parameter group menu.

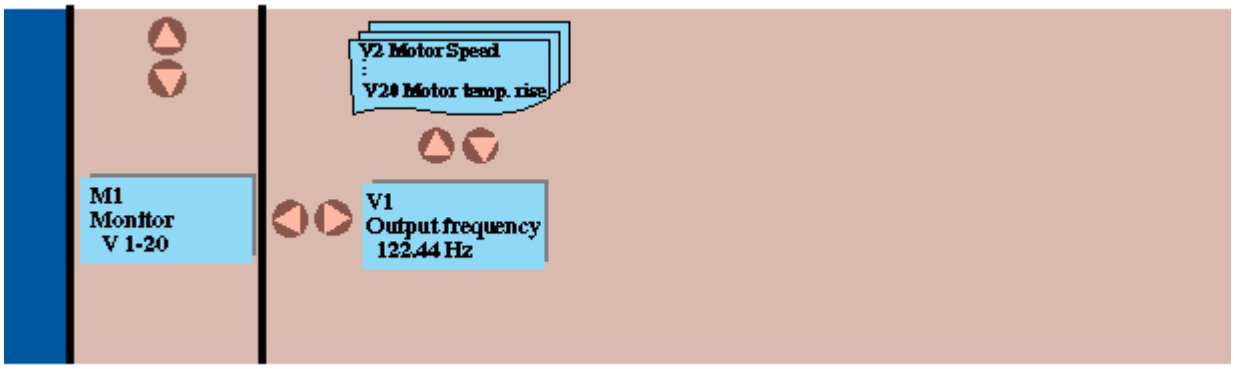


Figure 7.3-1 Monitoring menu

For the table of monitoring data that is displayed under the “Monitor” menu,
please consult Appendix 2 of the following Respondor 9000 AF Crane Control Application Manuals:
Publication No. 49485 - for AFDs with the standard 24VDC inputs
Publication No. 50248 - for AFDs with the 120VAC input card

7

7.4 Parameter group menu

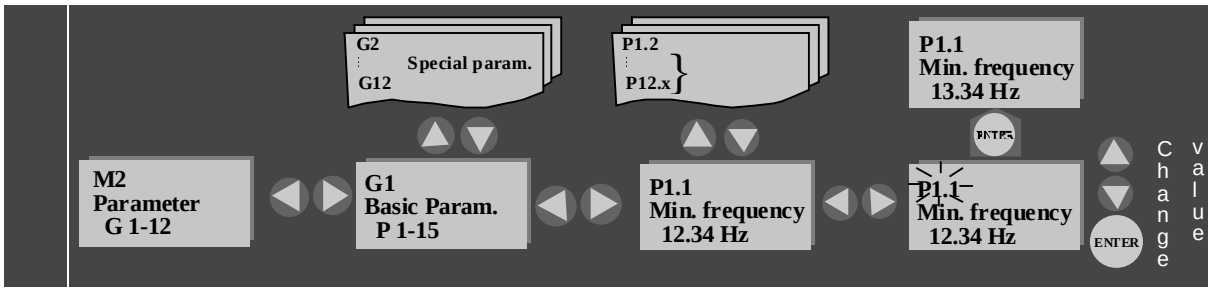
The parameter group menu can be entered from the main menu when the symbol **M2** is visible on the first line of the Multiline display. Parameter values are changed in the parameter menu as shown in Figure 7.4-1:
Push the menu button (right) once to move into the parameter group menu (G) and twice to enter the desired parameter menu. Locate the parameter you want to change by using the browser buttons. Push the menu button (right) once again to enter the edit menu. Once you are in the edit menu, the symbol of the parameter starts to blink. Set the desired new value with the browser buttons and confirm the change by pushing the Enter button. Consequently, the blinking stops and the new value is visible in the value field. The value will not change unless the Enter button is pushed.

Several parameters are locked, i.e. uneditable, when the drive is in RUN status. If you try to change the value of such a parameter, the text **locked** will appear on the display.
You can return to the main menu anytime by pressing the Menu button (left) for 2-3 seconds.

The basic application embodies only those parameters necessary for operating the device. The parameter group 0 is accessible only by opening the Application package lock.
.
Once in the last parameter of a parameter group, you can move directly to the first parameter of that group by pressing the browser button (up).

7

Figure 7.4-1 Parameter value change procedure



7.5 Reference menu

The reference menu can be entered from the main menu when the symbol **M3** is visible on the first line of the Multiline panel.

If the control panel is the active control source, the frequency reference can be changed by changing the value on the display with the browser buttons (for the selection of the active control source, see Chapter 7.6 Programmable push-button menu). See *Figure 7.5-1.*

Move deeper in the menu with the menu button (right) until the symbol **R1** starts to blink. Now you are able to alter the frequency reference value with the browser buttons. Pressing the Enter button is not necessary. Motor speed changes as soon as the frequency reference changes or the load inertia allows the motor to accelerate or decelerate.
In some applications, there might be several references.

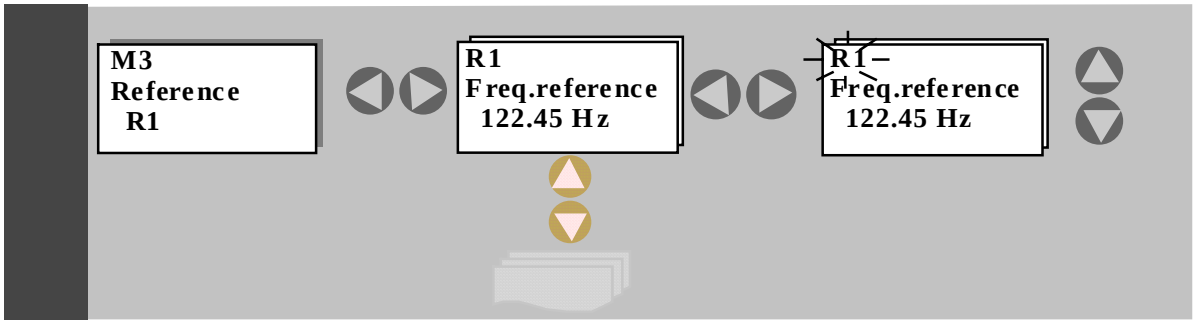


Figure 7.5-1 Reference setting on the control panel

7

7.6 Programmable push-button menu

The programmable push-button menu can be entered from the main menu when the symbol **M4** is visible on the first line of the Multiline display. In this menu, there are four functions for the Enter button. The functions are available in this menu only. In other menus, the button is used for its original purpose. The status of the controlled function is shown through a feedback signal.

Enter the edit menu with the menu button (right). Then, the symbol **B1** starts to blink. To change the button value, push the Enter button after which the new feedback value appears and the button sign **B** is replaced with a black square blinking together with the button number. After releasing the Enter button, the black square reverts to **B**. The new value stops blinking when the new value (e.g. reverse direction) has been received and put into operation. See Figure 7.6-1.

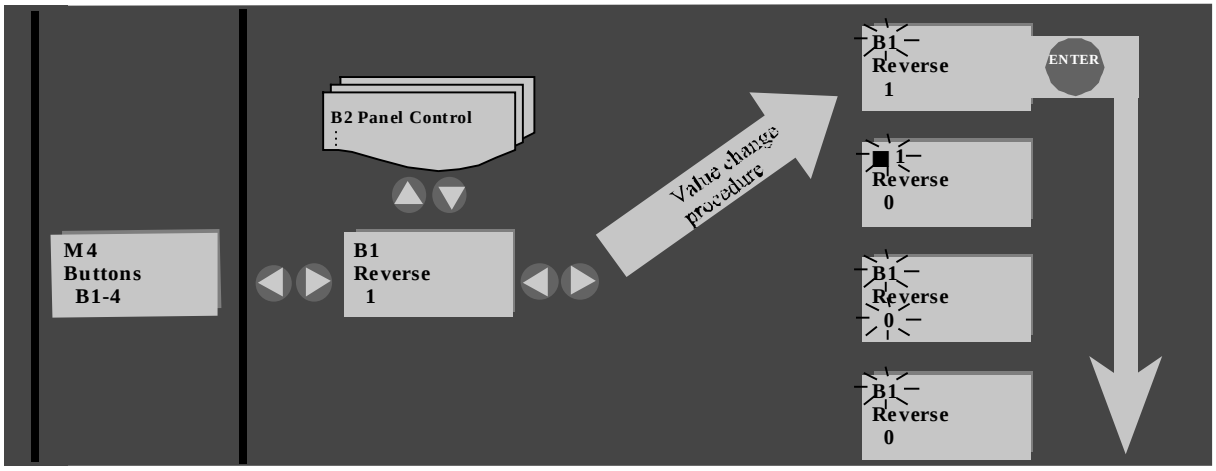


Figure 7.6-1 Programmable push-button menu

Button Number	Button Description	Function	Feedback information		
			0	1	Note
See 7.11 B1	Reverse	Changes the rotation direction f the motor. Available only when the control panel is the active control source	Forward	Backward	Feedback information flashes as long as the command is carried out.
See 7.11 B2	Active control source	Selection between I/O terminals and control panel	Control via I/O terminals	Control from the panel	
B3	Operating hours, trip counter reset	Resets the operating hours trip counter when pushed	No resetting	Reset of the operating hours trip counter	
B4	MWh trip counter reset	Resets the MWh trip counter when pushed	No resetting	Reset of the MWh trip counter	

7.7 Active Faults / Fault history menu

The active Faults are discussed in the application section.
The fault history menu can be entered from the main menu when the symbol **M6** is displayed on the first line of the Multiline panel.
The memory of the drive can store the up to the 9 latest faults in the order of appearance. The most recent fault has the number 1, the second latest number 2 etc.

If there are 9 uncleared faults in the memory, the next fault will erase the oldest from the memory.
Pressing the Enter button for about 2…3 seconds will reset the whole fault history. Then the symbol F# will change to 0. See figure 7.7-1.

Figure 7.7-1 Fault history menu

7.8 Contrast menu

The contrast menu can be entered from the main menu when the symbol **M7** is visible on the first line of the Multiline display.
Use the menu button (right) to enter the edit menu.

You are in the edit menu when the symbol **C** starts to blink. Then change the contrast using the browser buttons. The changes take effect immediately. See figure 7.8-1

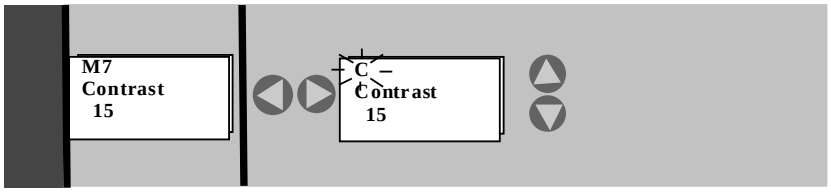


Figure 7.8-1 Contrast setting

7.9 Fault and Active warning display

When a fault occurs a text with a symbol **F#** appears on the display. When a warning occurs, a text with a symbol **A#** appears on the display.

The display does not have to be cleared in any special way for warnings. Faults require resetting of the drive.

A warning on the display does not disable the normal functions of the push buttons.

For the table of fault and warning codes,
please consult Appendix 1 of the following Respondor 9000 AF Crane Control Application Manuals:
Publication No. 49485 - for AFDs with the standard 24VDC inputs
Publication No. 50248 - for AFDs with the 120VAC input card

7.11 Controlling the motor from the panel

The RESPONDOR 9000 can be controlled from either the I/O terminals or the control panel. The active control source can be changed with the programmable push button b2 (see chapter 7.6). The motor can be started, stopped and the direction of rotation can be changed from the active control source.

Warning Use extreme caution and observers if line of sight is impaired

7.11.1 Control source change from I/O terminals to the panel

After changing the control source the motor is stopped. The direction of rotation remains the same as with I/O control.

If the Start button is pushed at the same time as the programmable pushbutton B2, the Run state, direction of rotation and reference value are copied from the I/O terminals to the panel.

7.11.2 Control source change from panel to I/O

After changing the control source, the I/O terminals determine the run state, direction of rotation and reference value.

If the motor potentiometer is used in the application, the panel reference value can be copied as the motor potentiometer reference by pushing the start button at the same time as the programmable push button B2. The motor potentiometer function mode must be "resetting at stop state" (Local/Remote Application: param. 1**.** 5 =4, Multi-purpose Application : param. 1**.** 5 = 9).

8. START UP

1 Internal components and circuit boards (except the isolated I/O terminals) are at utility potential when the RESPONDOR 9000 is connected to the line. This voltage is extremely dangerous and may cause death or severe injury if you come in contact with it

2 When the RESPONDOR 9000 drive is connected to the utility, the motor connections U, V, W and DC-link / brake resistor connections -,+ are live even if the motor is not running.

3 Do not make any connections when the RESPONDOR 9000 drive is connected to the utility line.

4 After disconnecting the utility, wait until the cooling fan on the unit stops and the indicators in the panel are turned off (if no panel is present check the indicators on the cover). Wait at least 5 minutes before doing any work on the RESPONDOR 9000 drive connections. Do not open cover before this time has run out.

5 The control I/O terminals are isolated from the utility potential but the relay outputs and other I/O's (if jumper X4 is in the OFF position, see fig. 6.2.2-1) may have dangerous external voltages connected even if the power is off from the RESPONDOR 9000 drive.

6 Before connecting the utility make sure that the cover of the RESPONDOR 9000 drive is closed.

8

8.2 Sequence of operation

1 Read and follow the safety precautions

2 After installation ensure that the:

- Drive and motor are connected to ground.
- Utility and motor cables are in accordance with the installation and connection instructions (chapter 6.1).
- Control cables are located as far as possible from the power cables (table 6.1.3-1), shields of the control cables are connected to the protective ground and wires do not have contact with any electrical components in the RESPONDOR 9000.
- The common input of digital input groups is connected to +24 V or
- ground of the I/O-terminal or external supply (See 6.2.3)
-

3 Check the quantity and quality of the cooling air (chapters 5.1 and 5.2).

4 Check that moisture has not condensed inside the RESPONDOR 9000 drive.

5 Check that all Start/Stop switches connected to the I/O terminals are in the **Stop** state.

6 Connect the RESPONDOR 9000 to the utility and switch the power ON.

7 Ensure that the parameters of the Group 1 match the application.

Set the following parameters to match the motor nameplate:

- nominal voltage of the motor
- nominal frequency of the motor
- nominal speed of the motor
- nominal current of the motor
- supply voltage

Look up the values from the nameplate of the motor.

8 Start-up test without motor

Perform either test A or B:

A *Control from the I/O terminals:*

- turn Start/Stop switch to ON position
- change the frequency reference
- check from the Monitoring page of the control panel that the output frequency follows the frequency reference
- turn Start/Stop switch to OFF position

B *Control from the Control Panel:*

- change control from the I/O terminals to the control panel with the programmable button B2, see chapter 7.6.
- push the Start button
- go to the Reference Page and change the frequency reference with the buttons , see chapter 7.5
- go to the Monitoring Page and check that the output frequency follows the reference, see chapter 7.3.
- push the Stop button

9

If possible, make a start-up test with a motor which is not connected to the process. If the inverter has to be tested on a motor connected to the process, ensure it is safe to be powered up. Inform all possible co-workers about the tests.

- switch the utility power OFF and wait until the RESPONDOR 9000 has powered down according to chapter 8.1/ point 4
- connect the motor cable to the motor and the power terminals of the RESPONDOR 9000
- check that all start/stop switches connected to the I/O terminals are in the OFF state
- switch the utility power ON
- repeat test **A** or **B** of the test #8.

10 Connect the motor to the process (if the previous tests were done without the process)

- ensure it is safe to power up
- inform all possible co-workers about the tests.
- repeat test **A** or **B** of the test #8.

8

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